EMITECH GROUPE

RR051-20-104233-5-A Ed. 0

Certification Radio test report

According to the standard:

CFR 47 FCC PART 15

RSS GEN – Issue 5
RSS 247 – Issue 3

Equipment under test:

S-LYNKS NODE

FCC ID: KQ9-0A00A

IC NUMBER: 1317A-0A00A

Company:

SERCEL Inc

Distribution: Mr TIJOU **(Company:** SERCEL NANTES)

Number of pages: 32 with 1 appendix

Ed.	Date	Modified Page(s)	Technical Verification and Quality Approval Name and Function / Visa
0	11-Mar-24	Creation	M. DUMESNIL, Radio Laboratory Manager

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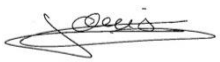
S51 RTY 000 INT 00015 [01]

DESIGNATION OF PRODUCT:	**S-LYNKS NODE**
Serial number (S/N):	EDE567C20251E0001
Reference / model (P/N):	NODE
Software version:	SLBB_ F V4 S36/20
MANUFACTURER:	SERCEL Inc

COMPANY CERTIFYING THE PRODUCT:

Company:	SERCEL Inc
Address:	17200 Park Row TEXAS 77084 UNITED STATES
Responsible:	Mr WENTZLER

COMPANY SUBMITTING THE PRODUCT:

Company:	SERCEL NANTES
Address:	16, RUE DU BEL AIR BP 30439 44470 CARQUEFOU FRANCE
Responsible:	Mr TIJOU
DATES OF TEST:	From 8-Dec-20 to 14-Dec-20
TESTING LOCATION:	EMITECH ANGERS laboratory at JUIGNE SUR LOIRE (49) FRANCE FCC Accredited under US-EU MRA Designation Number: FR0009 Test Firm Registration Number: 873677 ISED Accredited under CANADA-EU MRA Designation Number: FR0001 Industry Canada Registration Number: 4452A
TESTED BY:	S. LOUIS
VISA:	
WRITTEN BY:	S. LOUIS

CONTENTS

1. INTRODUCTION

This report presents the results of radio test carried out on the following radio equipment: **S-LYNKS NODE**, in accordance with normative reference.

The product integrates the followings radio functions:

- LoRa radio part not already certified,
- WiFi radio part not already certified,
- GNSS receiver.

This report concerns only LoRa radio part.

2. PRODUCT DESCRIPTION

Category of equipment (ISED):	I
Class:	A
Utilization:	Industrial
Antenna type and gain:	Integral antenna Gain at 903MHz => -0.01dBi Gain at 915MHz => +1.01dBi Gain at 927MHz => +2.93dBi
Operating frequency range:	From 902 MHz to 928 MHz
Frequencies tested:	903MHz, 915MHz, 927MHz
Number of channels:	41
Channel spacing:	600kHz
Modulation:	LoRa 500kHz / SF12
Max time on Air / Frame Coding rate Payload length Preamble length	250ms 4/5 12 octets 8 symbols
Power source:	7.2Vdc Li-ion battery
Power level adjusted to	+18dBm by software

Power level, frequency range and channels characteristics are not user adjustable.
The details pictures of the product and the circuit boards are joined with this file.

3. NORMATIVE REFERENCE

The standards and testing methods related throughout this report are those listed below.
They are applied on the whole test report even though the extensions (version, date and amendment) are not repeated.

CFR 47 FCC Part 15 (2020)	Radio Frequency Devices
ANSI C63.10	2013 Procedures for ComplianceTesting of Unlicensed Wireless Devices.
558074 D01 DTS v05 r02	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules.
RSP-100	Issue 12, August 2019 Certification of Radio Apparatus
RSS-Gen	Issue 5, April 2018 General Requirements for Compliance of Radio Apparatus
RSS-247	Issue 3, August 2023 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

4. TEST METHODOLOGY

Radio performance tests procedures given in CFR 47 part 15:

Subpart C – Intentional Radiators

- Paragraph 203: Antenna requirement
- Paragraph 205: Restricted bands of operation
- Paragraph 207: Conducted limits
- Paragraph 209: Radiated emission limits; general requirements
- Paragraph 212: Modular transmitter
- Paragraph 215: Additional provisions to the general radiated emission limitations
- Paragraph 247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

Radio performance tests procedures given in RSS-Gen:

- Paragraph 2 - General
- Paragraph 3 - Normative publications and related documents
- Paragraph 4 - Labelling requirements
- Paragraph 6 - General administrative and technical requirements
- Paragraph 8 - Licence-exempt Radio Apparatus

Radio performance tests procedures given in RSS-247:

- Paragraph 3 - Certification requirements
- Paragraph 4 - Measurement method
- Paragraph 5 - Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

5. TEST EQUIPMENT CALIBRATION DATES

Emitech Number	Model	Type	Last calibration	Calibration interval (years)	Next calibration due
0	BAT-EMC V3.18.0.26	Software	/	/	/
1406	EMCO 6502	Loop antenna	24/04/2020	1	24/04/2021
4393	Wainwright WLJS800-C11/60EE	Low Pass Filter	25/02/2020	3	24/02/2023
7171	R&S HL223	Antenna	19/04/2019	3	18/04/2022
7279	SUCOFLEX SF104 N 1.5m	Cable	11/06/2020	2	11/06/2022
7310	Filtek HP12/1200-5AA	High-pass filter	25/02/2020	3	24/02/2023
8511	HP 8447D	Low-noise amplifier	25/02/2020	1	24/02/2021
8526	Schwarzbeck VHBB 9124	Biconical antenna	17/08/2018	3	16/08/2021
8535	EMCO 3115	Antenna	28/04/2020	3	28/04/2023
8543	Schwarzbeck UHALP 9108A	Log periodic antenna	17/08/2018	3	16/08/2021
8578	N-2GHz	Cable	11/06/2020	2	11/06/2022
8593	SIDT Cage 2	Anechoic chamber	/	/	/
8707	R&S ESI7	Test receiver	29/06/2020	1	29/06/2021
8732	Emitech	OATS	03/07/2019	3	02/07/2022
8750	La Crosse Technology WS-9232	Meteo station	22/09/2020	2	22/09/2022
8855	EMITECH	Turntable and mat controller	/	/	/
8896	ACQUISYS GPS8	Satellite synchronized frequency standard	/	/	/
8972	K&L Microwave 500-1000MHz	Notch filter	/	/	/
10811	R&S EMC 32	Software	/	/	/
12911	Huber + Suhner N-2m	cable	11/06/2020	2	11/06/2022
14474	Oregon Scientific BAR206	Meteo station	19/11/2019	2	18/11/2021
14736	MATURO	Turntable and mat controller MCU	/	/	/
14831	Fluke 177	Multimeter	25/02/2020	2	24/02/2022
15666	R&S FSV40	Spectrum Analyzer	24/09/2020	2	24/09/2022
15812	COMP-POWER PAM-118A	Low-noise amplifier 18GHz	05/08/2020	1	05/08/2021
15882	SUCOFLEX	cable N 5m	28/01/2019	2	27/01/2021
//	RS Commander	Software	/	/	/

6. TESTS RESULTS SUMMARY

6.1 CFR 47 part 15requirements

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.203	ANTENNA REQUIREMENT	X				*Note 1*
FCC Part 15.205	RESTRICTED BANDS OF OPERATION	X				
FCC Part 15.207	CONDUCTED LIMITS			X		*Supplied by battery*
FCC Part 15.209	RADIATED EMISSION LIMITS; general requirements	X				*Note 2*
FCC part 15.215	ADDITIONAL PROVISIONS TO THE GENERAL RADIATED EMISSION LIMITATIONS					
	(a) Alternative to general radiated emission limits	X				
	(b) Unwanted emissions outside of §15.247 frequency bands	X				*Note 3*
	(c) 20 dB bandwidth and band-edge compliance	X				
FCC Part 15.247	OPERATION WITHIN THE BANDS 902-928 MHZ, 2400-2483.5 MHz and 5725-5850 MHz					
	(a) (1) Hopping systems			X		
	(a) (2) Digital modulation techniques	X				*Note 4*
	(b) Maximum peak output power	X				*Note 5*
	(c) Operation with directional antenna gains > 6 dBi			X		
	(d) Intentional radiator	X				
	(e) Peak power spectral density	X				
	(f) Hybrid system			X		
	(g) Frequency hopping requirements			X		
	(h) Frequency hopping intelligence			X		
	(i) RF exposure compliance	X				

NAp: Not Applicable NAs: Not Asked

Note 1: Integral antenna without standard connector.

Note 2: See FCC part 15.247 (d).

Note 3: See FCC part 15.209. Unwanted emissions levels are all below the fundamental emission field strength level.

Note 4: The minimum 6 dB bandwidth of the equipment is 759.92 kHz for LoRa 500kHz / SF12 Modulation.

Note 5: Conducted measurement is not possible (integral antenna), so we used the radiated method in open field.

6.2 RSS-Gen requirements

Test procedure	Description of test	Criteria respected ?				Comment
		Yes	No	NAp	NAs	
Paragraph 8	Licence-exempt radio apparatus					
§ 8.1	Measurement Bandwidths and Detector Functions	X				
§ 8.2	Pulsed operation	X				
§ 8.3	Prohibition of amplifiers	X				
§ 8.4	User manual notice	X				*see certification documents*
§ 8.5	Measurement of licence-exempt devices on-site (in-situ)			X		
§ 8.6	Operating frequency range of devices in master/slave networks	X				
§ 8.7	Radio frequency identification (RFID) devices			X		
§ 8.8	AC power line conducted emissions limits			X		*Supplied by battery*
§ 8.9	Transmitter emission limits	X				
§ 8.10	Restricted frequency bands	X				
§ 8.11	Frequency stability			X		

NAp: Not Applicable NAs: Not Asked

6.3 RSS-247 requirements

Test Procedure RSS-247	Description of test	Criteria respected ?				Comment
		Yes	No	NAp	NAs	
Paragraph 5	Standard specifications for frequency hopping system and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz					
5.1	Frequency hopping systems (FHSS)			X		
5.2	Digital transmission systems	X				*Note*
5.3	Hybrid systems			X		
5.4	Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) requirements	X				
5.5	Unwanted emissions	X				

NAp: Not Applicable NAs: Not Asked

Note: The minimum 6 dB bandwidth of the equipment is 759.92 kHz for LoRa 500kHz / SF 12 Modulation.

7. MEASUREMENT UNCERTAINTY

To declare, or not, the compliance with the specifications, it was not explicitly taken into account of uncertainty associated with the result(s)

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%.

Parameter	Emitech Uncertainty
RF power, conducted	± 0.75dB
Radiated emission valid to 26 GHz F < 62.5 MHz: 62.5 MHz < F < 1 GHz: 1 GHz < F < 26 GHz:	 ± 5.14 dB ± 5.13 dB ± 5.16 dB
AC Power Lines conducted emissions	± 3.38 dB
Temperature	± 1 °C
Humidity	± 5 %

8. OCCUPIED BANDWIDTH

Temperature (°C) : 20.5 **Humidity (%HR):** 36 **Date :** December 8, 2020
Technician : S. LOUIS

Standard: FCC Part 15
RSS-247

Test procedure:
Method of paragraphs 11.8 of ANSI C63.10 (6dB Measurement)
Method of paragraphs 6.9.3 of ANSI C63.10 (99% Measurement)

Test set up:

Test realized in near field.

Setting:

Measure	**6dB**	**99%**
Center frequency	The centre frequency of the channel under test	
Detector	Peak	
Span	2 to 5 times the OBW	1.5 to 5 times the OBW
RBW	100kHz	1% to 5% of the OBW
VBW	300kHz	3 x RBW
Trace	Max hold	
Sweep	Auto	

Test operating condition of the equipment:

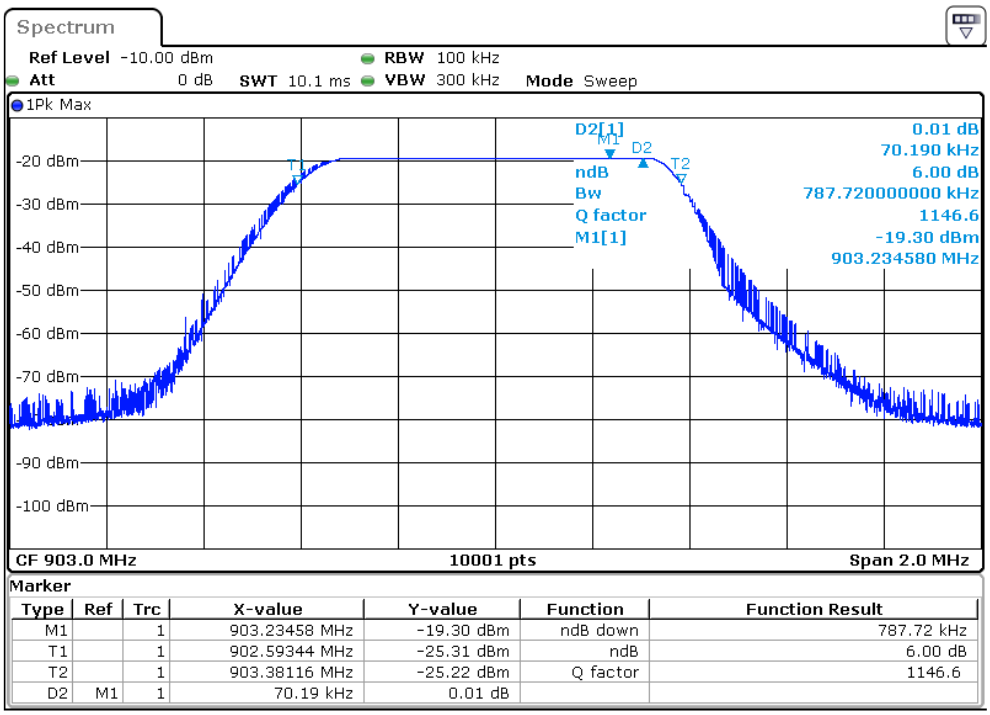
The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

We used for power source the internal battery pack of the equipment and we noted:
Voltage at the beginning of test (Vdc): 7.48
Voltage at the end of test (Vdc): 7.46
Percentage of voltage drop during the test (%): 0.27

Results:

Sample N° 1

6dB bandwidth – Channel 903 MHz – LoRa Modulation

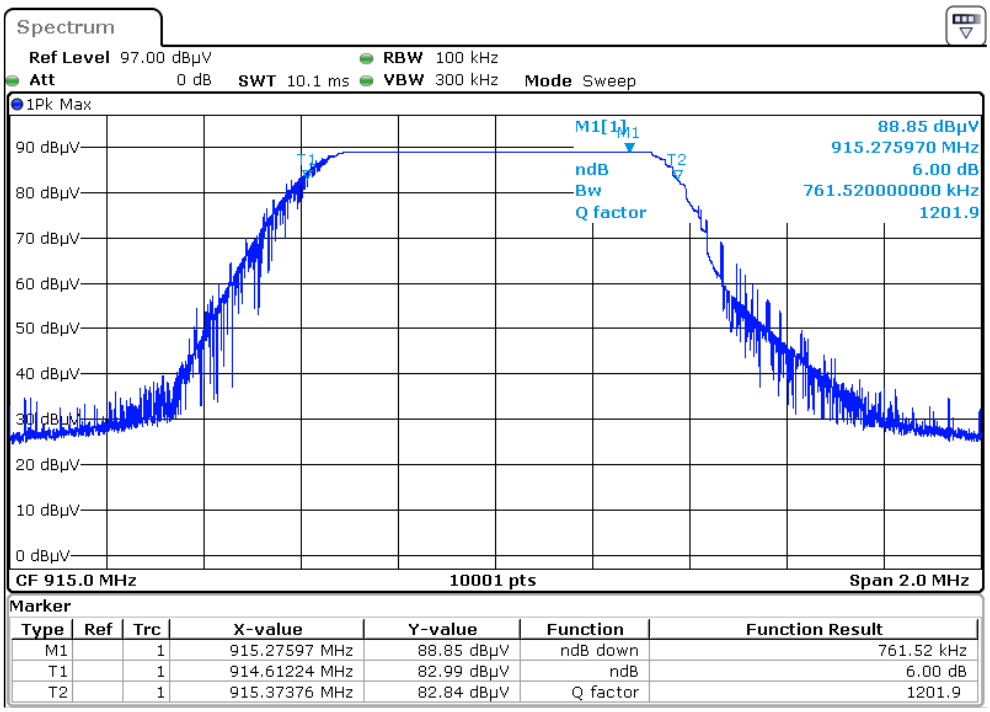


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	903.23458 MHz	-19.30 dBm	ndB down	787.72 kHz
T1		1	902.59344 MHz	-25.31 dBm	ndB	6.00 dB
T2		1	903.38116 MHz	-25.22 dBm	Q factor	1146.6
D2	M1	1	70.19 kHz	0.01 dB		

Measured bandwidth : 787.72 kHz

6dB bandwidth – Channel 915 MHz – LoRa Modulation

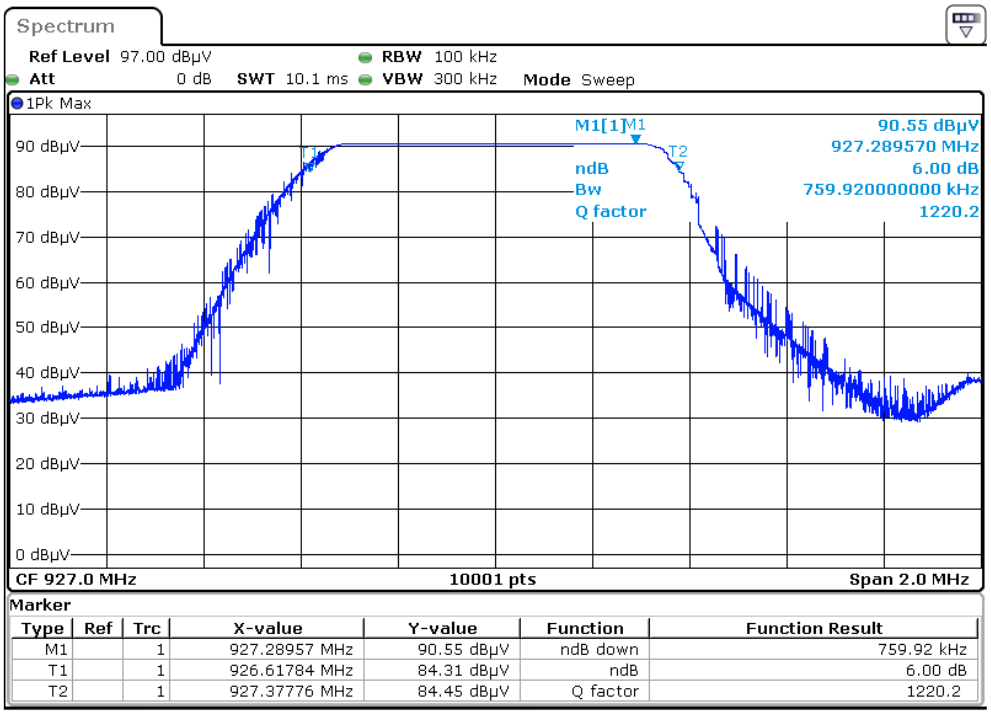


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	915.27597 MHz	88.85 dBµV	ndB down	761.52 kHz
T1		1	914.61224 MHz	82.99 dBµV	ndB	6.00 dB
T2		1	915.37376 MHz	82.84 dBµV	Q factor	1201.9

Measured bandwidth : 761.52 kHz

6dB bandwidth – Channel 927 MHz – LoRa Modulation

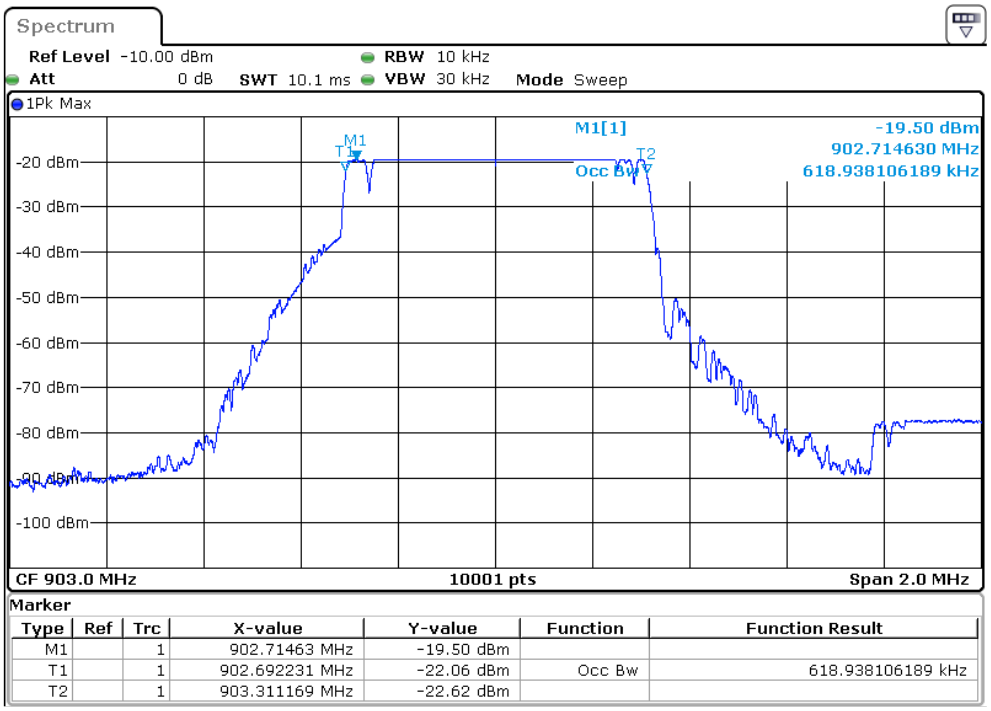


Measured bandwidth : 759.92 kHz

Limit:

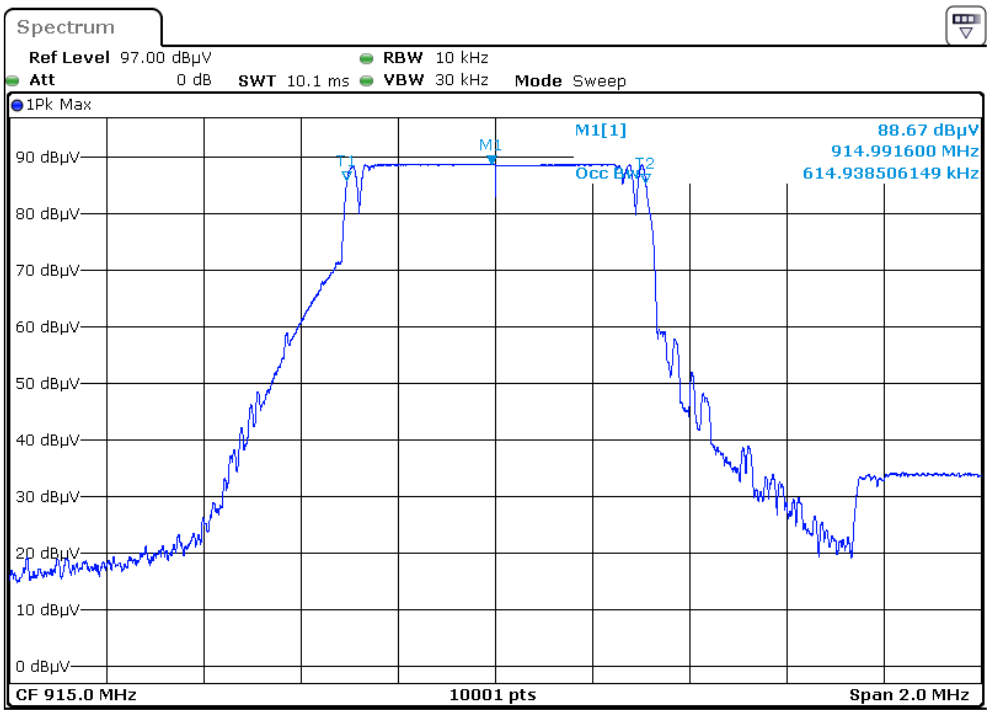
Shall be at least 500 kHz

99% bandwidth – Channel 903 MHz – LoRa Modulation



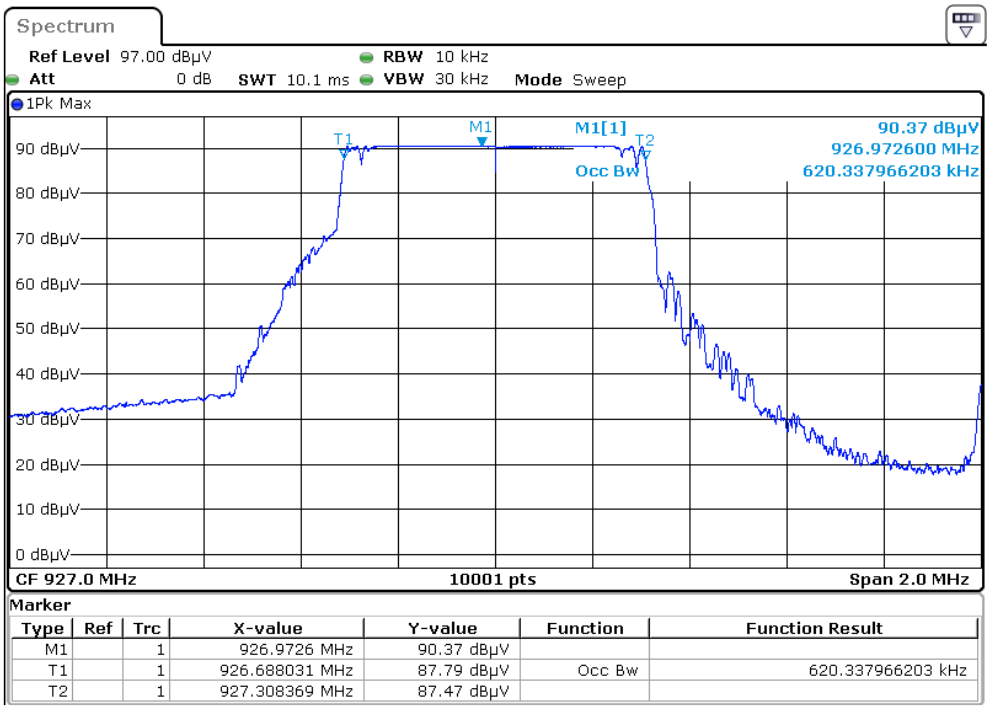
Measured bandwidth : 618.938 kHz

99% bandwidth – Channel 915 MHz – LoRa Modulation



Measured bandwidth : 614.938 kHz

99% bandwidth – Channel 927 MHz – LoRa Modulation



Measured bandwidth : 620.337 kHz

Measure realized for reporting only

9. *BAND EDGE*

Temperature (°C) : 20.5 **Humidity (%HR):** 36 **Date :** December 8, 2020
Technician : S. LOUIS

Standard: FCC Part 15
RSS-247

Test procedure:
Method of paragraph 11.13 of ANSI C63.10

Test set up:

Test realized in near field. All field strength measurements are correlated with the radiated maximum output power

Test operating condition of the equipment:

The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

P Software adjusted to +18dBm

We used for power source the internal battery pack of the equipment and we noted:
Voltage at the beginning of test (Vdc): 7.46
Voltage at the end of test (Vdc): 7.42
Percentage of voltage drop during the test (%): 0.53

Results:

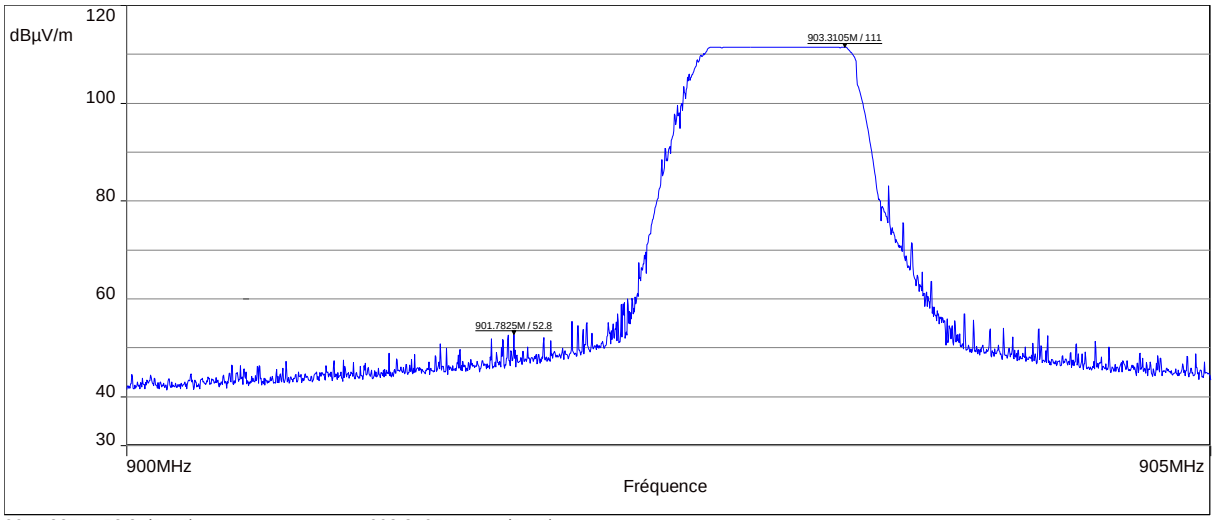
Lower Band Edge: From 900 MHz to 902 MHz
Upper Band Edge: From 928 MHz to 930 MHz

Sample N° 1

Fundamental frequency (MHz)	Field Strength Level of fundamental (dBµV/m at 3m)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB) (1)	Calculated Max Out-of-Band Emission Level (dBµV/m at 3m)	Limit (dBµV/m at 3m)	Margin (dB)
903	111.5	Peak	901.78	58.7	52.8	81.5	28.7
927	114.2	Peak	928.01	51.9	62.3	84.2	21.9

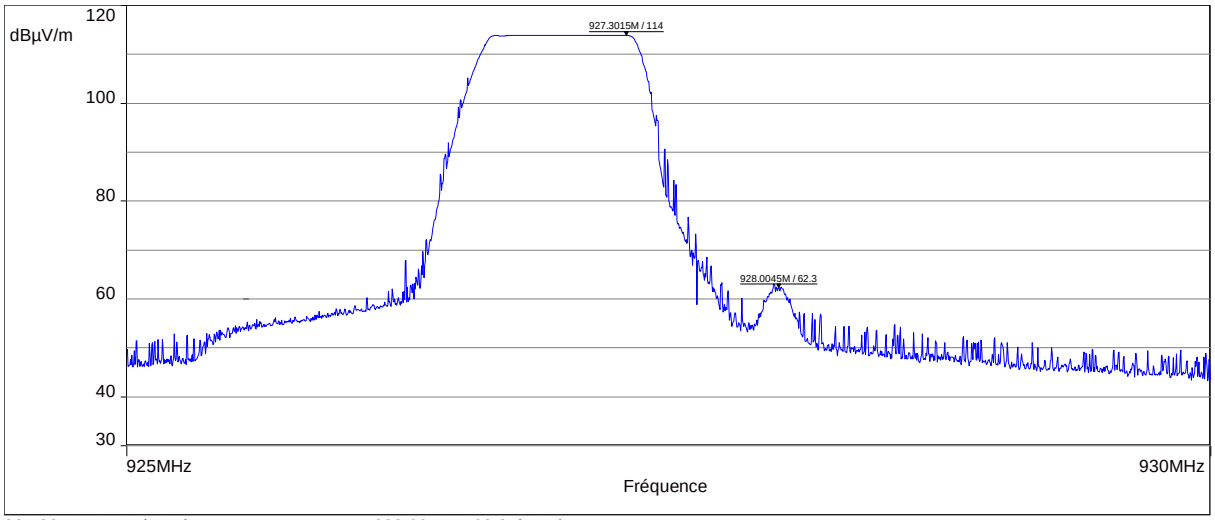
(1) Marker-Delta method

Low channel



901.7825M, 52.8 dBµV/m : 903.3105M, 111 dBµV/m :

High channel



927.3015M, 114 dBµV/m : 928.0045M, 62.3 dBµV/m :

Test conclusion:

RESPECTED STANDARD

10. CONDUCTED OUTPUT POWER

Temperature (°C) : 20.5 **Humidity (%HR):** 36 **Date :** December 8, 2020
Technician : S. LOUIS

Standard: FCC Part 15
RSS-247

Test procedure:
For FCC Part 15: paragraph 15.247 (b)
For RSS-247: paragraph 5.4

AVGSA-1 of paragraph 11.9.2.2.2 of ANSI C63.10

Test set up:

First an exploratory radiated measurement was performed.

During this phase the product is oriented in these two normal positions.

Then the final measurement is realized with the product on the most critical orientation.

The system is tested in an open area test site (OATS), the EUT is placed on a rotating table, 0.8m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

See photos in appendix 2.

Distance of antenna: 10 meters (in open area test site)

Antenna height: 1 to 4 meters (in open area test site)

Antenna polarization: vertical and horizontal (only the highest level is recorded)

The measure of average output power is measured with a spectrum analyzer:

Resolution bandwidth:	1% to 5% of the OBW, not to exceed 1 MHz.
Video bandwidth:	3 x RBW
Span:	At least 1.5 x OBW
Detector:	RMS
Sweep points:	At least 2 x SPAN/RBW
Sweep time:	Auto
Trace:	Average detector RMS
Trace Number:	At least 100 traces

Then channel power function is used to compute power on OBW band.

Finally the radiated electro-magnetic field is converted in dBm with the following formula:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna with a Gain (unit in dBi) different following the frequencies used.

Equipment under test operating condition:

The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

P Software adjusted to +18dBm

Results:

Sample N° 1 : Low Channel (F = 903 MHz)

	Electro-magnetic field (dBµV/m at 10m)	Maximum conducted output power		Limit (W)
		(dBm)	(W)	
Nominal supply voltage:	101.1	16.31	0.043	1

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

Maximum conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = -0.01dBi.

Sample N° 1 : Central Channel (F = 915 MHz)

	Electro-magnetic field (dBµV/m at 10m)	Maximum conducted output power		Limit (W)
		(dBm)	(W)	
Nominal supply voltage:	102.0	16.19	0.042	1

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

Maximum conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = +1.01dBi.

Sample N° 1 : High Channel (F = 927 MHz)

	Electro-magnetic field (dBµV/m at 10m)	Maximum conducted output power		Limit (W)
		(dBm)	(W)	
Nominal supply voltage:	103.8	16.07	0.040	1

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

Maximum conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = +2.93dBi.

Test conclusion:

RESPECTED STANDARD

11. RADIATED SPURIOUS EMISSIONS

Temperature (°C) : 20.5 **Humidity (%HR):** 36 **Date :** December 8, 2020
Technician : S. LOUIS

Standard: FCC Part 15
RSS-247

Test procedure:
For FCC Part 15: paragraph 15.205, paragraph 15.209, paragraph 15.247 (d)
For RSS-247: paragraph 5.5

Emissions in non-restricted frequency bands method of paragraph 11.11 of ANSI C63.10
Emissions in restricted frequency bands method of paragraph 11.12 of ANSI C63.10

Test set up:

First an exploratory radiated measurement was performed.

During this phase the product is oriented in these two normal positions.

Then the final measurement is realized with the product on the most critical orientation.

The measure is realized on open area test site under 1 GHz and in anechoic chamber above 1 GHz.

When the system is tested in an open area test site (OATS), the EUT is placed on a rotating table, 0.8m from a ground plane.
When the system is tested in anechoic chamber, the EUT is placed on a rotating table, 1.5 m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

Frequency range: From 9 kHz to10GHz (10^{th} harmonic of the highest fundamental frequency (927MHz)

Detection mode: Quasi-peak (F < 1 GHz) Peak / Average (F > 1 GHz)

Bandwidth: 200Hz (9 kHz < F < 150kHz)
9 kHz (150 kHz < F < 30MHz)
120 kHz (30 MHz < F < 1 GHz)
100 kHz / 1 MHz (F > 1 GHz)

Distance of antenna: 10 meters (in open area test site) / 3 meters (in anechoic room)

Antenna height: 1 to 4 meters (in open area test site) / 1.5 meter (in anechoic room)

Antenna polarization: vertical and horizontal (only the highest level is recorded)

Equipment under test operating condition:

The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

P Software adjusted to +18dBm

We used for power source the internal battery pack of the equipment and we noted:

Voltage at the beginning of test (Vdc):	7.46
Voltage at the end of test (Vdc):	7.42
Percentage of voltage drop during the test (%):	0.53

Results:

Sample N° 1 Low Channel (F = 903 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3 m (dBµV/m)	Limits at 3 m (dBµV/m)	Margin (dB)
1805.8	P	150	100	1	H	62.8	84.2	21.4
2709.6 (1)	P	150	1000	1	H	59.2	74	14.8
2709.6 (1)	Av	150	1000	1	H	54.0	54	0
3612 5 (1)	P	150	1000	1	H	55.9	74	19.6
3612 5 (1)	Av	150	1000	1	H	50.9	54	3.1
4514.7 (1)	P	150	1000	1	H	56.5	74	18.5
4514.7 (1)	Av	150	1000	1	H	51.4	54	2.6
5415.9 (1)	P	150	1000	1	H	59.8	74	14.2
5415.9 (1)	Av	150	1000	1	H	54.0	54	0
6321.2	P	150	100	1	H	53.3	84.2	30.9
7223.6	P	150	100	1	H	48.8	84.2	35.4

P= Peak, QP=Quasi-peak, Av=Average
(1) Restricted bands of operation in 15.205
(1) Restricted bands of operation as defined in Table 6 of RSS-Gen

Sample N° 1 Central Channel (F = 915 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3 m (dBµV/m)	Limits at 3 m (dBµV/m)	Margin (dB)
1829.6	P	150	100	1	H	59.5	84.2	24.7
2744.6 (1)	P	150	1000	1	H	59.1	74	14.9
2744.6 (1)	Av	150	1000	1	H	53.9	54	0.1
3659.7 (1)	P	150	1000	2	V	55	74	19
3659.7 (1)	Av	150	1000	2	V	50	54	4.0
4574.7 (1)	P	150	1000	1	H	54.8	74	19.2
4574.7 (1)	Av	150	1000	1	H	49.7	54	4.3
5491.2	P	150	100	1	H	62.6	84.2	21.6
6405.2	P	150	100	1	H	49.1	84.2	35.1
7321.2	P	150	100	1	H	48.7	84.2	35.5

P= Peak, QP=Quasi-peak, Av=Average
(1) Restricted bands of operation in 15.205
(1) Restricted bands of operation as defined in Table 6 of RSS-Gen

Sample N° 1 High Channel (F = 927 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3 m (dBµV/m)	Limits at 3 m (dBµV/m)	Margin (dB)
1854	P	150	100	1	H	51.0	84.2	33.2
2781.6 (1)	P	150	1000	1	H	59.2	74	14.7
2781.6 (1)	Av	150	1000	1	H	54	54	0
3708 (1)	P	150	1000	2	V	55.3	74	18.7
3708 (1)	Av	150	1000	2	V	50.3	54	3.7
4635 (1)	P	150	1000	1	H	54.3	74	19.7
4635 (1)	Av	150	1000	1	H	49.2	54	4.8
5561.1	P	150	100	1	H	64.4	84.2	19.8
6488	P	150	100	1	H	47.6	84.2	36.6

P= Peak, QP=Quasi-peak, Av=Average
(1) Restricted bands of operation in 15.205
(1) Restricted bands of operation as defined in Table 6 of RSS-Gen

Applicable limits: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

The highest level recorded in a 100 kHz bandwidth is 114.2 dBµV/m at 3m on High channel. So the applicable limit is 84.2 dBµV/m at 3m.

In addition, radiated emissions which fall in the restricted band, as defined in section 15.205 (a), must also comply with the radiated emission limits specified in section 15.209 (a) (see section 15.205 (c)).

In addition, radiated emissions which fall in the restricted band, as defined in Table 6 of RSS-Gen, must also comply with the radiated emission limits specified in Table 4 and Table 5 of RSS-Gen.

Test conclusion:

RESPECTED STANDARD

12. CONDUCTED POWER SPECTRAL DENSITY

Temperature (°C) : 20.5 **Humidity (%HR):** 36 **Date :** December 8, 2020
Technician : S. LOUIS

Standard: FCC Part 15
RSS-247

Test procedure:
For FCC Part 15: paragraph 15.247 (e), paragraph 15.247 (f)
For RSS-247: paragraph 5.2

AVGPSD-1 of paragraph 11.10.3 of ANSI C63.10

Test set up:

First an exploratory radiated measurement was performed.

During this phase the product is oriented in these two normal positions.

Then the final measurement is realized with the product on the most critical orientation.

The system is tested in an open area test site (OATS), the EUT is placed on a rotating table, 0.8m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

See photos in appendix 2.

Distance of antenna: 10 meters (in open area test site)

Antenna height: 1 to 4 meters (in open area test site)

Antenna polarization: vertical and horizontal (only the highest level is recorded)

The measurement of the radiated electro-magnetic field is realized with an analyser.

Span:	1MHz
Resolution bandwidth:	3kHz
Video bandwidth:	10kHz
Detector:	RMS
Number of points:	4001
Sweep time:	Auto
Trace mode:	Average Power

Then the peak marker function is used.

Finally the radiated electro-magnetic field is converted in dBm with the following formula:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna with a Gain (unit in dBi) different following the frequencies used.

Equipment under test operating condition:

The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

P Software adjusted to +18dBm

We used for power source the internal battery pack of the equipment and we noted:

Voltage at the beginning of test (Vdc):	7.46
Voltage at the end of test (Vdc):	7.42
Percentage of voltage drop during the test (%):	0.53

Results:

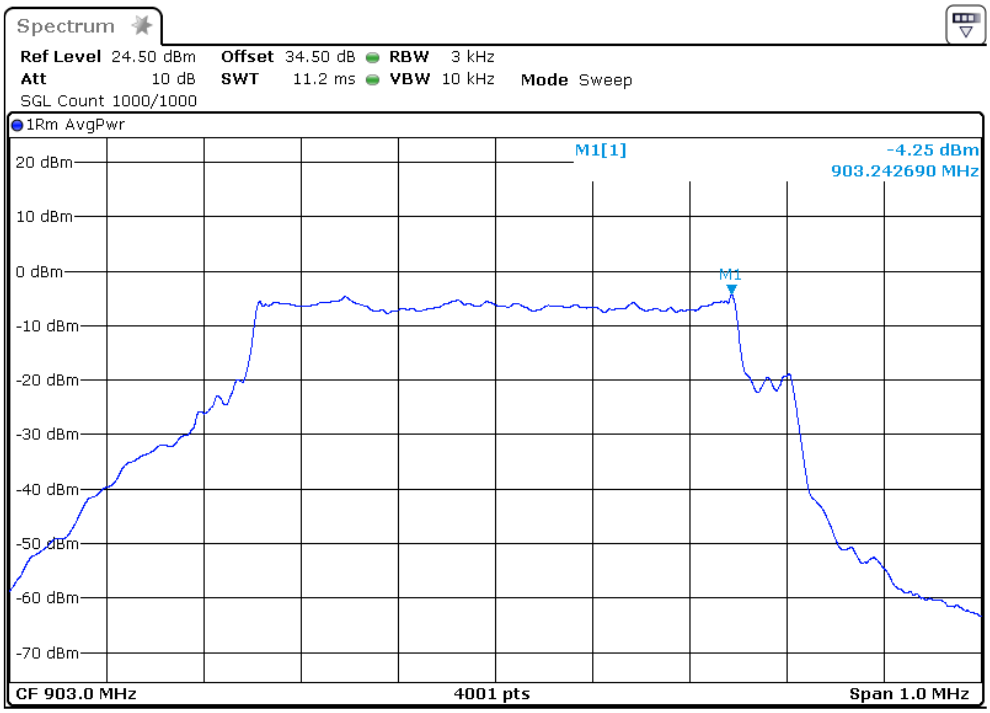
Sample N° 1 : Low Channel (F = 903 MHz)

	Electro-magnetic field (dBµV/m at 10m)	Maximum conducted power density(1) (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage:	80.52	-4.27	8

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

Maximum Peak conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = -0.01dBi.

In the following graph, the offset on analyser is considered in the measure with the compensation of cables loss, antenna gain and space loss at 10 meters.



Sample N° 1 : Central Channel (F = 915 MHz)

	Electro-magnetic field (dBµV/m at 10m)	Maximum conducted power density(1) (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage:	81.13	-4.68	8

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

Maximum Peak conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = +1.01dBi.

In the following graph, the offset on analyser is considered in the measure with the compensation of cables loss, antenna gain and space loss at 10 meters.

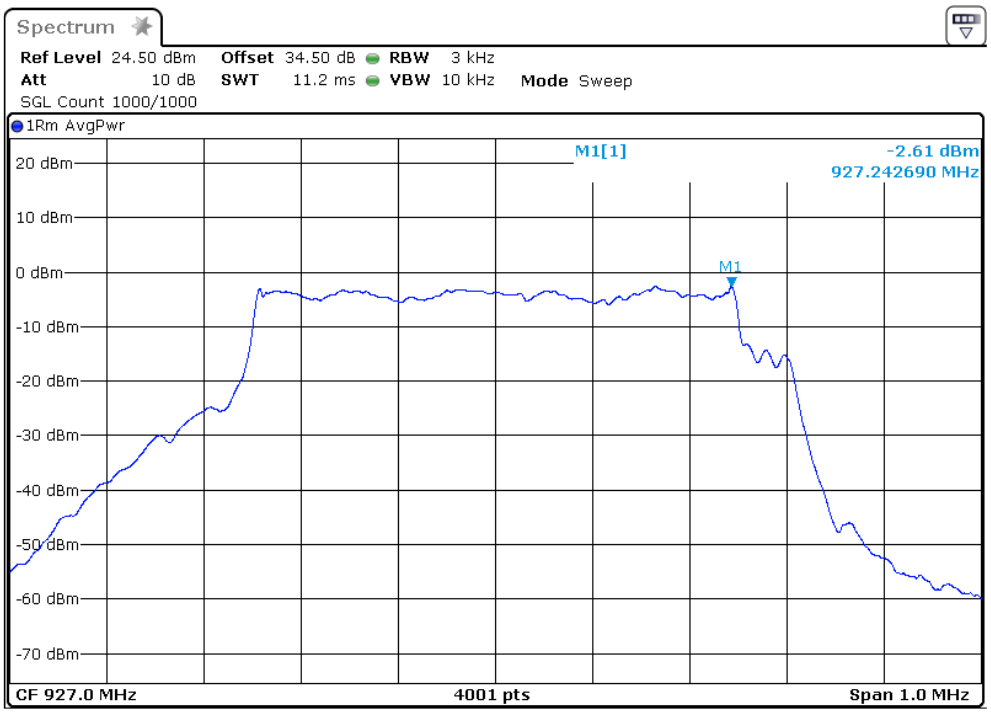
Sample N° 1 : High Channel (F = 927 MHz)

	Electro-magnetic field (dBµV/m at 10m)	Maximum conducted power density(1) (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage:	82.16	-5.57	8

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

Maximum Peak conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = +2.93dBi.

In the following graph, the offset on analyser is considered in the measure with the compensation of cables loss, antenna gain and space loss at 10 meters.



Test conclusion:

RESPECTED STANDARD

□□□ End of report, 1 appendix to be forwarded □□□

APPENDIX 1: Test equipment list

Occupied bandwidth

TYPE	MANUFACTURER	EMITECH NUMBER
Anechoic Chamber	EMITECH	8593
Turntable controller 1060C	MATURO	14736
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
Log periodic antenna UHALP 9108A	Schwarzbeck	8543
N-2M Cable	Huber + Suhner	12911
N-5M Cable	SUCOFLEX	15882
Multimeter 177	Fluke	14831
Meteo station WS-9232	La Crosse Technology	8750
Software	RS Commander	-

Band edge

TYPE	MANUFACTURER	EMITECH NUMBER
Anechoic Chamber	EMITECH	8593
Turntable controller 1060C	MATURO	14736
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
Log periodic antenna UHALP 9108A	Schwarzbeck	8543
N-2M Cable	Huber + Suhner	12911
N-5M Cable	SUCOFLEX	15882
Multimeter 177	Fluke	14831
Meteo station WS-9232	La Crosse Technology	8750
Software Commander V1.6.4	Rohde et Schwarz	//

Conducted output power

TYPE	MANUFACTURER	EMITECH NUMBER
Open test site	EMITECH	8732
Turntable and mat controller	EMITECH	8855
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Test receiver ESI7	Rohde & Schwarz	8707
Log periodic antenna HL223	Rohde & Schwarz	7171
N-3GHz Cable	Emitech	8578
Multimeter 177	Fluke	14831
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.18.0.26	0000

Radiated spurious emissions

TYPE	MANUFACTURER	EMITECH NUMBER
Open test site	EMITECH	8732
Turntable and mat controller	EMITECH	8855
Anechoic Chamber	EMITECH	8593
Turntable controller 1060C	MATURO	14736
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Test receiver ESI7	Rohde & Schwarz	8707
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
Loop antenna 6502	EMCO	1406
Biconical antenna VHBB 9124	Schwarzbeck	8526
Log periodic antenna UHALP 9108A	Schwarzbeck	8543
Log periodic antenna HL223	Rohde & Schwarz	7171
Antenna 3115	EMCO	8535
Low-noise amplifier 8447D	Hewlett Packard	8511
Low-noise amplifier PAM-118A	COM-POWER	15812
N-1.5M Cable	SUCOFLEX	7279
N-2M Cable	Huber + Suhner	12911
N-5M Cable	SUCOFLEX	15882
Notch filter 500-1000MHz	K&L Microwave	8972
Low pass filter WLJS800-C11/60EE	Wainwright	4393
High pass filter HP12/1200-5AA	Filtek	7310
Multimeter 177	Fluke	14831
Meteo station BAR 206	Oregon Scientific	14474
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.18.0.26	0000

Conducted power spectral density

TYPE	MANUFACTURER	EMITECH NUMBER
Open test site	EMITECH	8732
Turntable and mat controller	EMITECH	8855
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
Log periodic antenna HL223	Rohde & Schwarz	7171
N-3GHz Cable	Emitech	8578
Multimeter 177	Fluke	14831
Meteo station WS-9232	La Crosse Technology	8750
Software Commander V1.6.4	Rohde et Schwarz	//